Chapter 25
Human Fragilities Supported by the Digital Social World

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ABSTRACT

Technological progress must aim at creating Society 5.0 by developing tools to support people. This contribution aims to show how modern technologies and their integration into society can support people with fragility. In particular, the authors present the prototype of a technology that the Turin Polytechnic has developed to provide an IoT device control tool for people with motor neuron degeneration. This, through the use of eye-trackers and building information models (BIM), allows the navigation of models in virtual reality and interaction with different devices and services. Furthermore, the use of micro-services and the use of standard exchange formats allow easy integration with different services. The authors want to show how it is possible to build applications that, by bridging the real and the visual, can restore autonomy and quality of life to the frailest people.

INTRODUCTION

The condition of human fragility can be identified in all those individuals who fall into a state of physiological vulnerability like older people or people suffering from chronic diseases that debilitate the body. Modern technological development and the mindset characterizes by the 5.0 society, have contributed to the emergence of tools to support humans, not only to perform actions automatically or with less effort, but also to communicate and have new experiences. To have a better understanding of the direction in

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which research is currently heading and the potential developments in the coming years in connection with autonomy and the quality of life of the frailest people, a literature review is conducted on various topics. The analysis of the literature makes it clearer how topics that may appear to be separate and not integrable are indispensable for the construction of a digital social world capable of supporting fragile human beings.

In this chapter, the authors focus in particular on the analysis and development of systems to support sufferers of motor neuron degeneration. Among the diseases that affect motor neurons is Amyotrophic Lateral Sclerosis (ALS) (Vichi, 2016). This disease affects one in three of every 100,000 people in the world between the ages of 50-65 but can occur even earlier. One of the first symptoms that occur with the onset of the disease is depression, due to the inability to perform simple actions and communicate efficiently with the people around them (S. Zarei, 2015). To support people affected by this frailty, the SIRIO technology was born, developed by the departments of structural engineering, construction and geotechnics (DISEG) and automatic and computer science (DAUIN) of the Polytechnic of Turin (F. Alotto, 2019). This technology was developed to allow, through the use of eye-trackers, virtual models and IoT devices, simple actions and virtual experiences to be performed just by moving the eyes. Interaction with the virtual environment is done through the use of the Building Information Model (BIM), It is defined as "a digital representation of physical and functional characteristics of a facility. […] It serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward" (BuildingSMARTalliance, 2007). This is used as a starting point for the implementation of Digital Twins (DT) (Grieves, 2014) which combine static building data with dynamic data derived from sensors and actuators.

The format that is used to allow the exchange of information and the integration with the different services that make up the system is the .ifc (Industry Foundation Classes) format (BuildingSMART International, 2022). This format enables the import of building geometries into different applications to improve visualization, and it also permits the use of BIM model data for various purposes, such as the management of IoT devices.

Thanks to the great development of Industry 4.0, Internet of Things (IoT) devices today can connect people with people, people with objects, or objects with objects. In recent years is also born out the concept of the Social Internet of Things (SIoT), i.e. the ability of connected objects to autonomously understand the context in which they operate and support human decisions (Rho Seungmin, 2019). The IoT devices implemented in the SIRIO system can be commanded by users to turn on lights or change the temperature of the room, and data is sent to a telemedicine system that collects the user's vital parameters and allows the doctor to make examinations without having to physically visit the patient. The Healthcare sector is one of the sectors where IoT technology has grown strongly (S. R. Islam, 2015), this is also caused by the wide range of parameters that need to be constantly monitored to enable efficient telemedicine services such as glucose, saturation, blood pressure or ECG. Constant monitoring of these parameters can be of great help in diagnosis and emergency interventions.

Currently, people with motor neuron degeneration use devices to increase their communication skills. The most common devices are Speech Generating Devices (SGDs) or devices for Eye-Tracking and Eye-Gaze detection. Generally, eye-detection can be used by any type of patient with a movement inability, and they are mainly based on infrared systems that hit the eye, illuminating it. In this way, it is possible to trace corneal movements using the Corneal Centre Pupil Reflection (PCCR).